FOREST CONTROL by CONTINUOUS INVENTORY

"Today I have grown taller from walking with the trees."
...Karle Wilson

Milwaukee, Wis. April, 1960 No. 73

THE EVOLUTIONARY VISION

The important ends of man's life include the creation and enjoyment of beauty, both natural and man-made; increased comprehension and a more assured sense of significance; the preservation of all sources of pure wonder and delight, like fine scenery, wild animals in freedom, or unspoiled nature; the attainment of inner peace and harmony; the feeling of participation in embracing and enduring projects, including the cosmic project of evolution. It is through such things that individuals attain greater fulfillment.

Sir Julian Huxley

The University of Chicago Magazine - January, 1960

CAL STOTT

The Falcon

4/25/60

THE BLOCK GRID

It has long been a problem, when establishing a timber survey, to determine the sampling design or plot location for a selected ownership. This was true in the line plot method on the "one-shot" cruises in use only a few years ago, and it is true with the mechanical spacing of permanent plots in common use today.

Line plot cruising was generally done with the specific attempt to get a certain per cent of sample. This involved the location of cruise lines a certain distance apart and plots spaced at regular intervals along these lines. The data collected from these cruises were generally figured and computed by many hours of tedious hand work.

We have in recent years moved rather quickly into the field of permanent plot locations with precise measurements on circular, fixed radius plots. The data collected on these plots are now manipulated for us on the business accounting machines. This has brought drastic changes in the methods used to get answers. One of the changes is the sampling of less area. Actually a small fraction of 1% of an area is now sampled, as compared with considerably larger percentages in the line plot method. This has made the number of plots in a cruise a more significant figure than previously. Now, there is a very definite relationship between per cent of cruise and accuracy of cruise, but this relationship is not as important as the actual number of plots and the variability of the timber.

Of equal importance in determining the number of plots which should be established are various economic factors, such as manpower available, money budgeted to do the work and the time available in which to do the job. These three items play a more important part than they sometimes should, but there is no escaping the fact that they must be primary considerations.

The intensity of sample for most plot surveys ranges between 1 plot = 100 acres to 1 plot = 400 acres. Using this range, a single grid was developed that would:

1. Be usable on any of the commonly found map scales.

2. Enable the buildup (or reduction) in the sampling intensity.to any desirable level by other than a trial and error basis.

These points were accomplished by dividing an acetate sheet into 9 large blocks that were 5 inches square. Each of the 9 blocks was then divided into 64 small squares or units (8 units on a side) with the center of each unit representing a possible plot location. Each unit center (or plot location) within each block was then given a number from 1 to 64, in the same manner as sections are numbered in a township. This produced a grid with systematic spacing of similarly numbered points (possible plot locations) located in equal size groups (blocks) and having a continuity between blocks (the entire grid).

To use the grid, the first thing to do is determine the order in which the individual numbers within each block are considered for possible plot locations. To do this, numbers 1 to 64 are selected at random* and recorded on a sheet of paper. Then you determine how many of these randomly selected points should be examined to get a certain number of plots in the ownership being considered. This can roughly be determined by comparing the map scale and the grid scale with the desired intensity of sampling. (Refer to "EXAMPLE"). The selected point numbers are then circled in each block of the grid with a china marking pencil. At this point, the grid is ready to be applied to maps on which has been delineated the ownership that is being sampled.

In use, the grid is placed over a map and keyed in by placing grid reference marks on the map. This permits the orientation of the same grid on the same map in exactly the same position at any time. The randomly selected numbers that were circled are then examined in each block to determine if ownership dictates their choice as sample plots. Those points on "selected ownership" become possible field points and are pricked through to, and marked on the map. Each one so selected is temporarily recorded so as to provide a record of plots selected for each of the starting numbers. This process is repeated on all maps and the orientation of the grid is a progressive operation assuring complete coverage of the total area without overlap in coverage.

If the total number of plots obtained is adequate, the temporarily marked points become permanent field locations on the map. They must now be located on the ground and the necessary measurements taken on the trees.

If for some reason an insufficient number of plots is obtained, the intensity is built up by going back and selecting one or more of the additional random numbers, orienting the grid by using the reference marks and by examining these points in each block. This process is repeated until the desired intensity is established. By the same token, intensity could be reduced from the originally selected points.

EXAMPLE

Map scale: 2" = 1 mile. A 5" square has the equivalent of 4006 acres.

Scale of grid: 64 dots in a 5" square.

Total area of "selected ownership" = 168,000.

Number of plots desired = 700.

$$\text{Acres represented by each plot} = \frac{168{,}000}{700} = 240 \text{ acres.}$$

$$\frac{\text{Area of a block}}{\text{Acres per plot}} = \frac{4006}{240} = 16.69 \text{ or } 17 \text{ points.}$$

* The selection of numbers at random does not make this a random grid. The spacing of the points is mechanical and the grid must therefore be considered a mechanical one.

EXAMPLE OF BUILD-UP OF SAMPLING INTENSITY USING THE BLOCK GRID

NUMBER OF PLOTS DESIRED - 700. KNOWN AREA OF SELECTED OWNERSHIP - 186,000 ACRES

Order of Random Selection of Numbers: 1 - 64	Grid Point Number Selected	Number of Points Counted: Other Than Selected Ownership	Number of Points Counted: Selected Ownership: Per Start	Number of Points Counted: Selected Ownership: Cumulative	Per cent of Area (As represented by Points Occurring in Selected Ownership + Total Number of Points Considered)	Acres Represented by Each Plot (Known Area of Selected Ownership + Plots Occurring in Selected Ownership
1	24	13	59	59	81.9	2,847.5
2	22	36	36	95	66.0	1,768.4
3	19	14	58	153	70.8	1,098.0
4	56	45	27	180	62.5	933.3
5	53	24	48	228	63.3	736.8
6	25	32	40	268	62.0	626.9
7	17	38	34	302	59.9	556.3
8	38	29	43	345	60.0	487.0
9	7	30	42	387	59.7	434.1
10	64	27	45	432	60.0	388.9
11	58	32	40	472	59.6	355.9
12	47	21	51	523	61.6	321.2
13	1	46	26	549	58.7	306.0
14	30	35	37	586	58.1	286.7
15	42	39	33	619	57.3	271.4
16	3	24	48	667	57.9	251.9
17	36	36	36	703	57.4	239.0
18	55					
19	9					
20	27					
etc. to 64	etc.					

Advantages of Grid

1. Permits the use of the same grid on any scale map regardless of intensity of sampling desired.

2. Permits the user to gradually build up the intensity of sample to the desired level. (Except for certain extremes, which are not possible due to the scale of the grid).

3. Permits the establishment of a skeleton system of plots that may eventually be built up to an increased intensity at some undetermined future date, without disrupting existing intensity pattern.

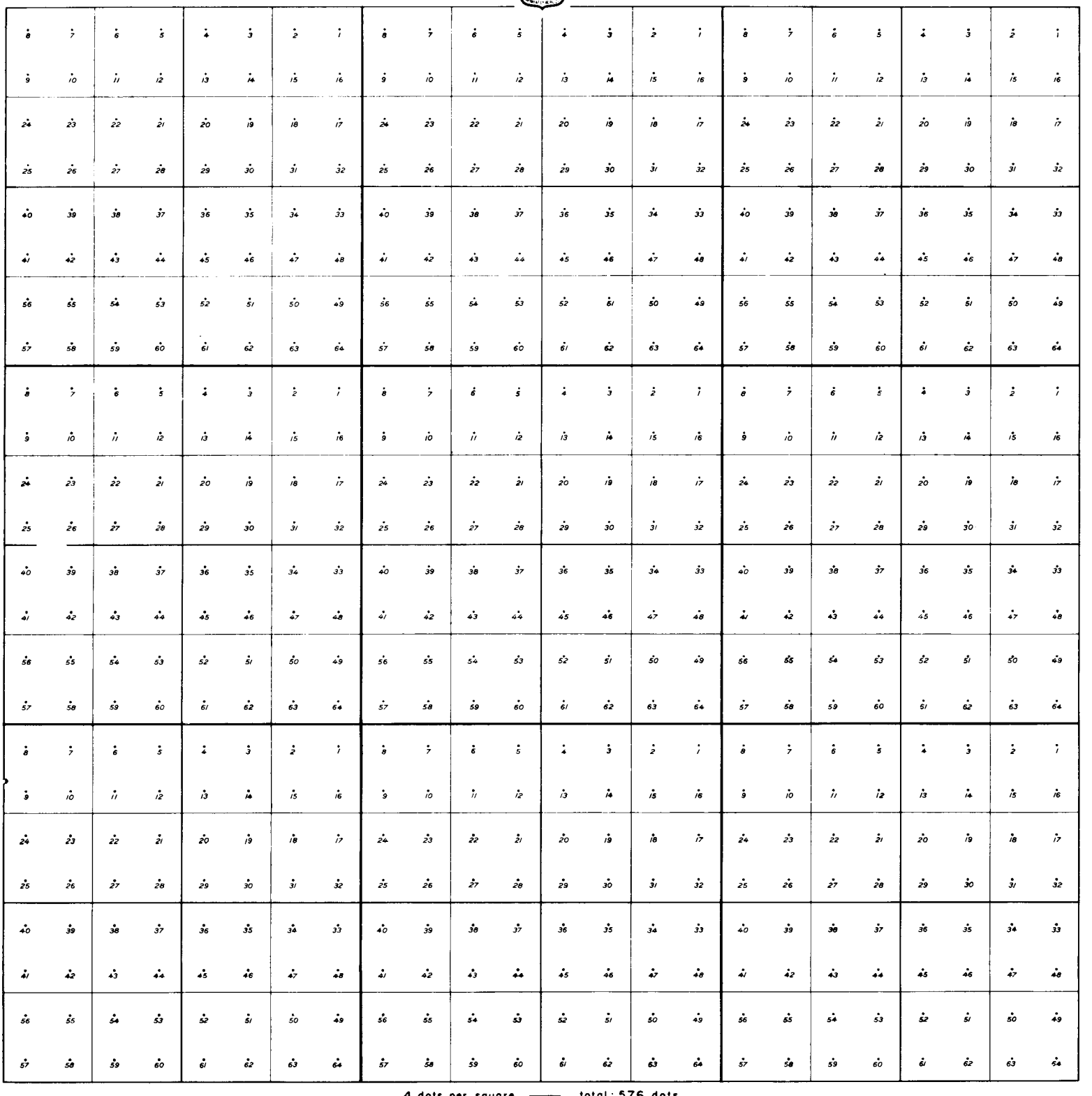
4. Eliminates trial and error in getting a satisfactory mechanical spacing of plots.

5. Could set the framework for plot location to selectively supplement a permanent plot inventory system on a certain area by adding temporary plots to obtain data to bring the survey to a desirable basis for operational purposes.

6. Determines plot location for temporarily intensifying the sampling in certain strata for specific answers.

7. Within certain limitations, permits the use of the same grid on maps of different scales while maintaining the approximate intensity of sampling.

George Semmens
Forester, Div. of State & Pri. For.



4 dots per square —— total: 576 dots

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No. 10 × 10

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STATISTICAL PROCEDURE LEAFLET #5

HOW TO CALCULATE THE COEFFICIENT OF VARIATION (c)

When the standard deviation (σ) is divided by the calculated average of all samples (M), there results a figure which very well describes the relative uniformity of the stand. This quotient is known as the coefficient of variation (c).

Different stands with the same coefficient of variation require the same number of samples to produce averages of equal accuracy. For this reason, the coefficient of variation is the most important statistical term to have (or to be able to judge) when attempting to balance work and accuracy in a sampling plan.

The coefficient of variation may be derived from the standard deviation and the calculated average; or it may be calculated directly from the sample records. Using figures from Statistical Leaflet #3, (and the symbols therein also); 1/

$$\text{coefficient of variation (c)} = \frac{\text{standard deviation } (\sigma)}{\text{calculated average } (M)}$$

$$= \frac{1.109 \text{ cords}}{3.140 \text{ cords}}, \text{ or } 0.353$$

The coefficient of variation may be calculated directly from the sample records with the data processing machine formula:

$$c^2 = \left(\frac{N(\Sigma X^2)}{(\Sigma X)^2} - 1\right)\left(\frac{N}{N-1}\right)$$

$$= \left(\frac{12\ (131.840019)}{1419.707041} - 1\right)\left(\frac{12}{12-1}\right)$$

$$= \left(\frac{1582.080228}{1419.707041} - 1\right)\left(\frac{12}{11}\right)$$

$$= (1.114370 - 1)\ (1.090909)$$

$$= (0.114370)\ (1.090909)$$

$$= 0.124767$$

$$\text{and } c = \sqrt{0.124767}, \text{ or } 0.353$$

Since the standard deviation (σ) is seldom used, and it is the square of the coefficient of variation (c^2) that is useful, the direct data processing machine formula is to be preferred. The square root was extracted here just to show that the identical figure is calculated by either method.

1/ See C.F.I. Newsletter #71, February, 1960 - Statistical Procedure Leaflet #3.

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